Space Weather Technical Forecast

Issued on Sunday, 02 April 2023 at 00:16 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of Minor Geomagnetic Storms throughout. Active electron fluence likely.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours, with only C-class flares observed, the largest of which was a C6.8 at 01/0325 UTC. There are currently two numbered and one unnumbered sunspot regions on the disc. All appear to be small and simple with very little magnetic complexity. No Earth directed Coronal Mass Ejections (CMEs) have been detected in available imagery.

Solar Wind / Geomagnetic Activity: The solar wind, as measured at L1 by ACE and DSCOVR, was characterised by continued HSS influence. Solar wind speeds were Slightly Elevated around 470km/s to start, quickly rising to Elevated speeds of 520-580m/s through much of the period. Density was below average. The phi angle was mostly negative (towards the Sun) but with periodic fluctuations to positive (away from the Sun), particularly at the start of the period. The IMF was weak (below 8nT), with fluctuations between +6/-6nT in the north-south component. The result of the above solar wind measures was for Quiet to Unsettled (Kp 1-3) geomagnetic activity, with one Active interval (Kp 4) 01/1500-01/1800 UTC.

Energetic Particles / Solar Radiation: High energy proton enhancement (greater than 10MeV) has been at background levels.

The high energy electron flux (greater than 2MeV), as measured at GOES16 has been at moderate to high levels much of the period, with a peak of 3.74e3 pfu observed at 01/1525 UTC, but has recently seen a reduction back towards background levels. The associated 24-hour fluence was below the Active (1e8 integrated pfu) threshold to start but on a rising trend, risking above the active threshold from 01/1800 UTC and recording 1.18e8 integrated pfu at 02/0001UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to remain Low, though confidence reduces through the period.

Solar Wind / Geomagnetic Activity: No Earth Directed CMEs are expected, though there have been multiple small but complex CMEs within the last few days, with a very slight chance of glancing blows at Earth during Days 1 and 2

Solar wind speeds currently at Elevated levels, and a generally Slightly Elevated to Elevated speed flow looks likely to persist through Days 1 and 2, complicated by any transitory CME impacts. During Day 3 and into Day 4 Earth will likely see the effect of approaching coronal holes 89 and 90, with CH90/- in the southern hemisphere expected to be the dominate feature. Solar wind speeds expected to rise to Elevated or perhaps Strong levels.

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Generally Quiet to Unsettled geomagnetic activity is expected, with Active intervals likely and a chance of G1/Minor Storm intervals due to CH HSS activity and possible transitory CME effects. Into Day 2 and Day 3, Unsettled to Active geomagnetic activity is expected, with a chance of G1/Minor storming due to the likely arrival of the CH HSS of CH90/- and the continuing risk of CME glancing blows.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV), as observed by GOES-16 is at background levels and is expected to remain so pending any further developments.

The flux at GEO has been at Moderate to High levels in recent hours. This is expected to generally continue. Geomagnetic activity likely at times however with ongoing HSS and possible transitory CME effects either of which could see the flux at GEO temporarily reduced back towards normal background, adding uncertainty to the forecast. Fluence levels are above the Active threshold currently and expected to remain generally so, though confidence is low given uncertainty in the flux at GEO.

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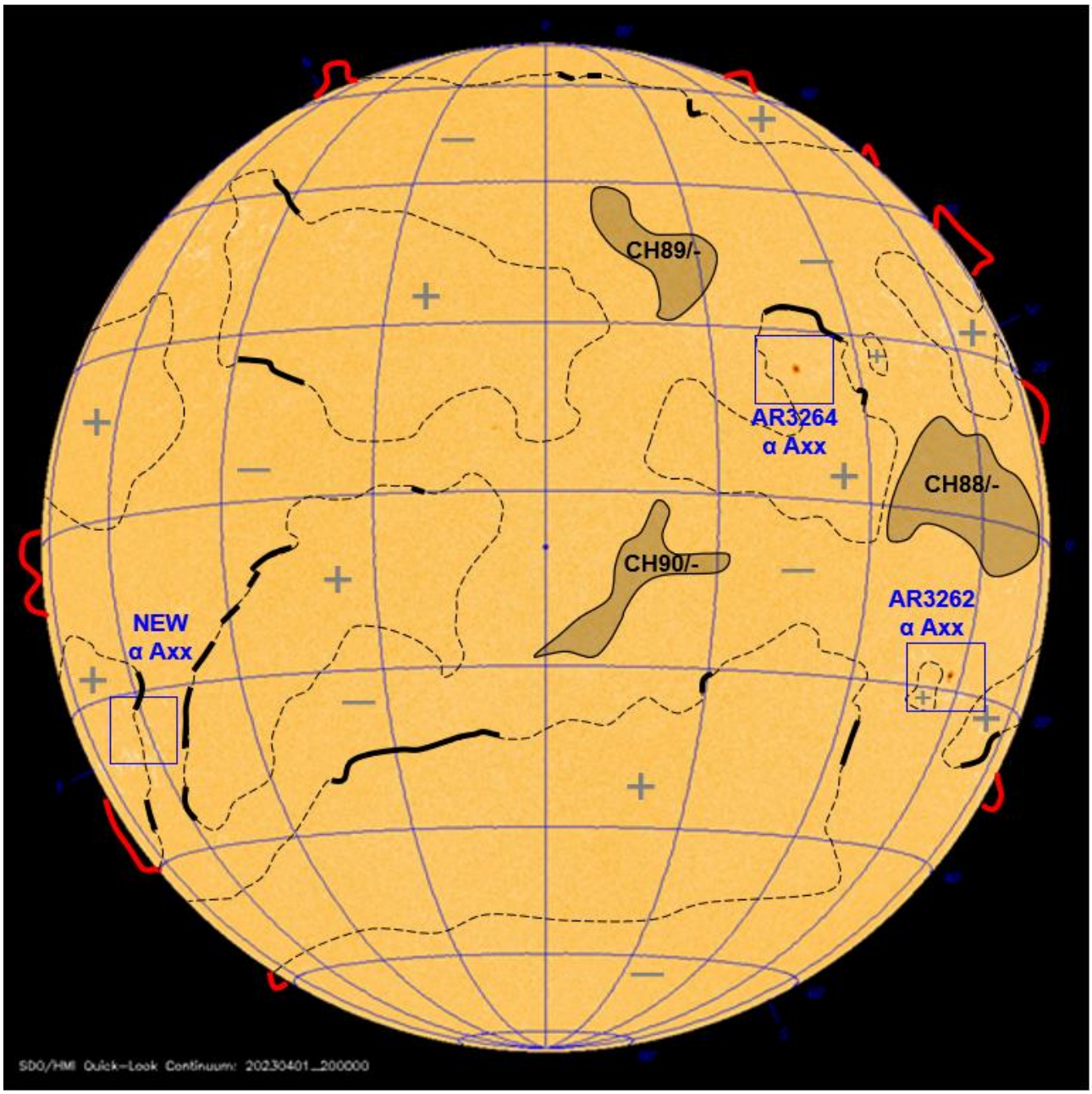
Figure 1. Solar Analysis Valid 01/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No Earth Directed CMEs are expected, though there have been multiple small but complex CMEs within the last few days, with a very slight chance of glancing blows at Earth during Days 1 and 2 (2nd and 3rd of April) showing within a minority of MOSWOC ENLIL perturbations. The most likely of these looks to be associated with a 29 March prominence eruption from the southeastern limb. The Earth appears to experiencing lingering effects of CH88/-, with speeds currently at Elevated levels, and a generally Slightly Elevated to Elevated speed flow looks likely to persist through Days 1 and 2, complicated by any transitory CME impacts. During Day 3 and into Day 4 Earth will likely see the effect of approaching coronal holes 89 and 90, with CH90/- in the southern hemisphere expected to be the dominate feature. Solar wind speeds expected to rise to Elevated or perhaps Strong levels.

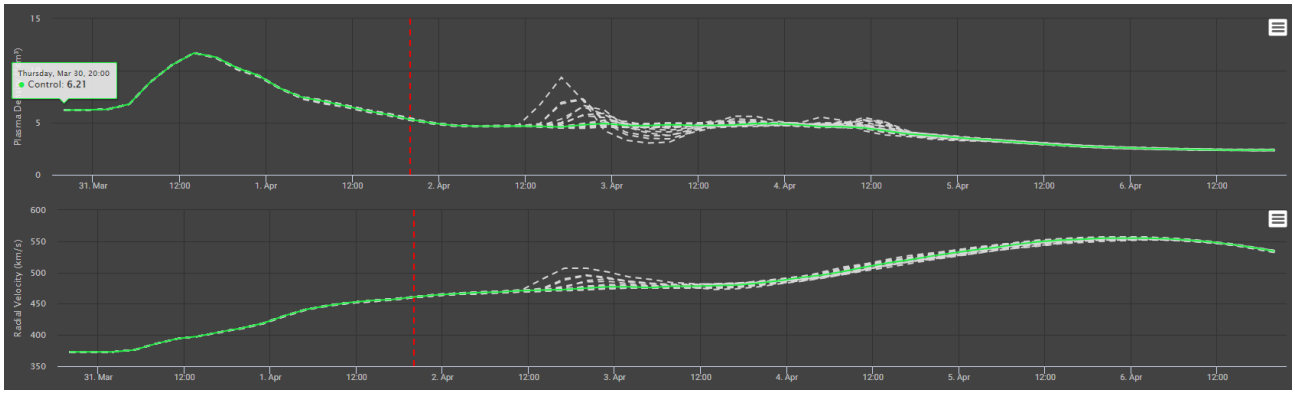
Generally Quiet to Unsettled geomagnetic activity is expected, with Active intervals likely and a chance of G1/Minor Storm intervals due to CH HSS activity and possible transitory CME effects. Into Day 2 and Day 3, Unsettled to Active geomagnetic activity is expected, with a chance of G1/Minor storming due to the arrival of the CH HSS of CH90/- and the continuing risk of CME glancing blows.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	30	50	50	30
Strong	G3	No	1	5	5	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity – Earthbound Coronal Mass Ejections

Nil

Figure 2: Latest MOSWOC ENLIL Ensemble output, showing possible glancing CME impacts.



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Radio Blackouts - X-Ray Flares:
The four-day forecast period is currently expected to see a generally muted flare risk due to only relatively few, simple regions currently on the visible disk, particularly to start.

Returning regions signalled to potentially arrive during the period, although for now there are no major signs of increased activity from STEREO A EUVI imagery or flux looping from beyond the eastern limb. Soundings suggest the most active of these region most likely into Days 3 and 4, but these regions will be assessed as and when they present for analysis.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	5	5	5	10
Very Active	R3 to R5 X Class	No	1	1	1	1

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Solar Radiation Storms - (High Energy Protons):
High energy proton flux (greater than 10MeV), as observed by GOES-16 is forecast to remain at background levels pending any further developments.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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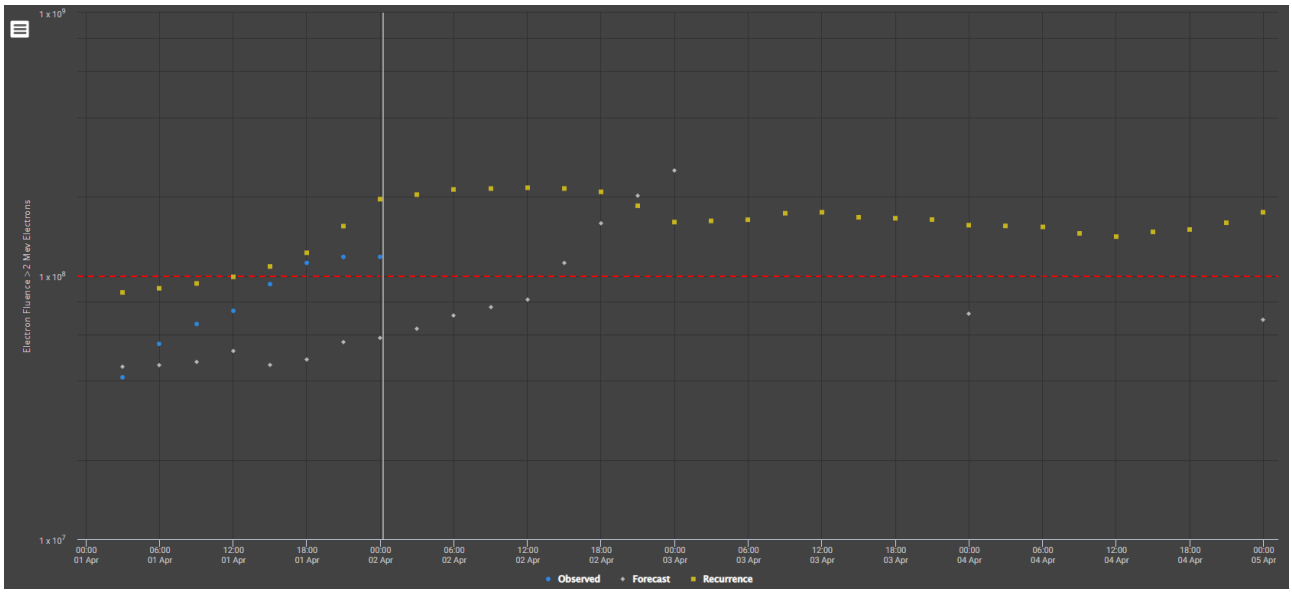
High Energy Electrons Event (≥ 2MeV):
The flux at GEO has been at Moderate to High levels in recent hours. This is thought likely to generally continue due to the persistent elevated solar winds. Geomagnetic activity likely at times however with ongoing HSS and possible transitory CME effects either of which could see the flux at GEO perhaps temporarily reduced back towards normal background, adding uncertainty to the forecast. Fluence levels are above the Active threshold currently and expected to remain generally so, though confidence is low given uncertainty in the flux at GEO. MOSWOC REFM forecast is a little muted in its expected response, with persistence preferred at this stage.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	Yes	80	70	50	50
Very Active	≥ 2 MeV ≥ $1x10^9$	No	5	5	1	1

Figure 3: Latest MOSWOC REFM model output.



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